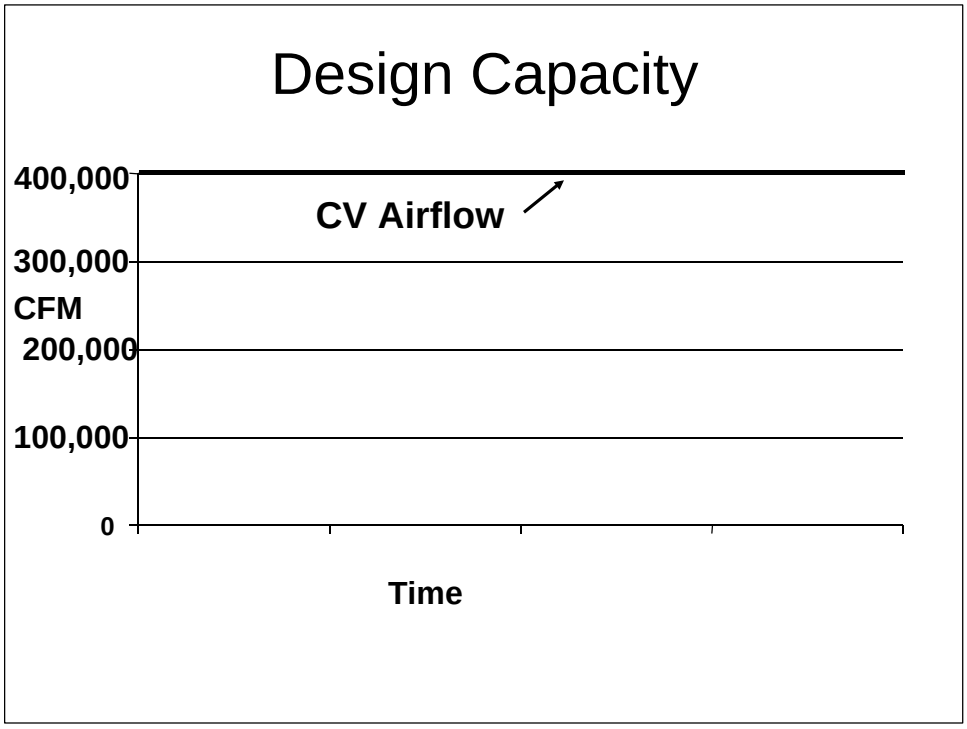
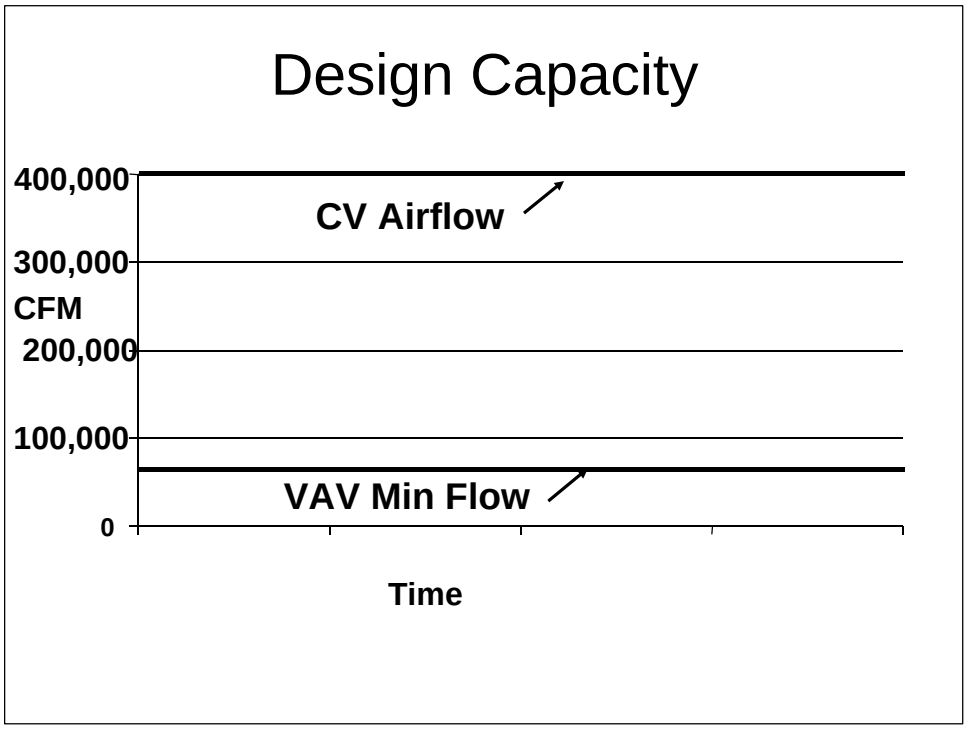
Achieving Energy Efficient Laboratory Buildings

Reducing the flow through the fume hood system

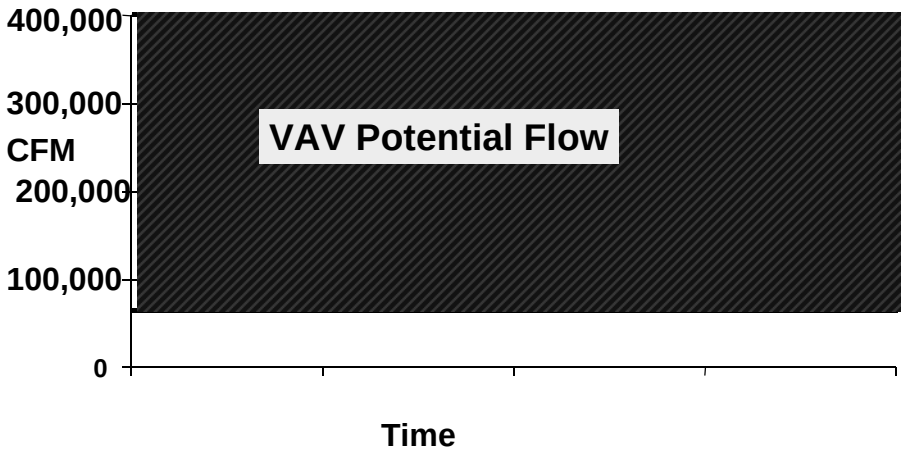
Case Study: Chemistry Building Renovation

- 250 Hoods: 8’
- Traditional Sizing: 400,000 CFM
- Goal: Provide only 160,000 CFM (Avoids adding new AHU system & offers $700,000/Year energy savings)


Design Capacity
400,000
CV Airflow
300,000
CFM
200,000
100,000
0
Time


Design Capacity
400,000
CV Airflow
300,000
CFM
200,000
100,000
VAV Min Flow
0
Time

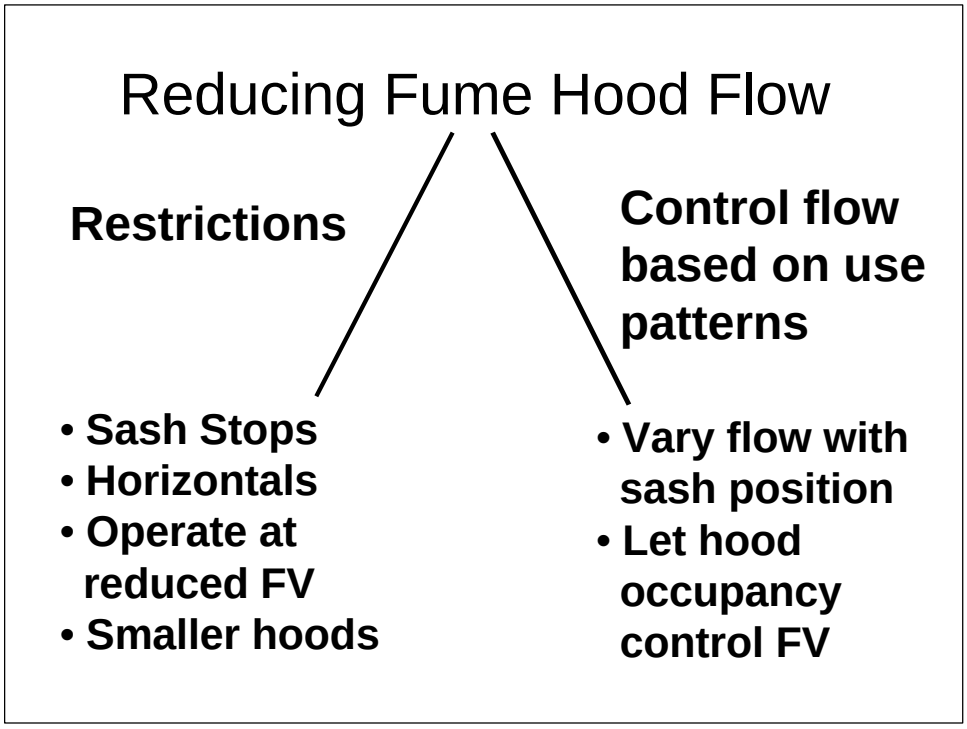
Design Capacity

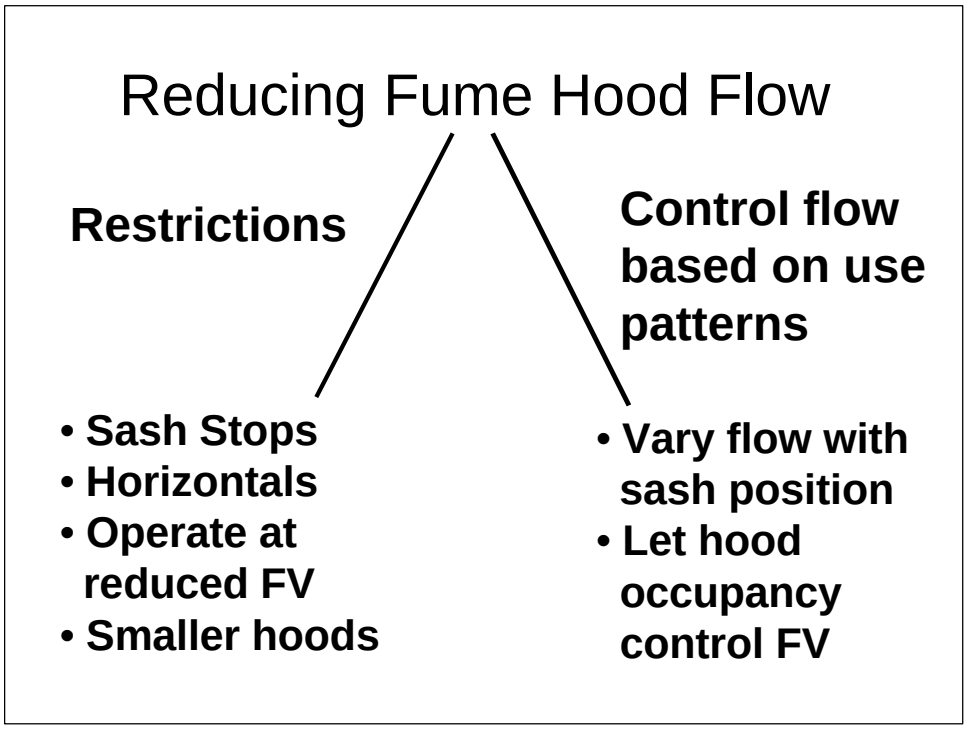


Reducing Fume Hood Flow

Restrictions

- **Sash Stops**
- **Horizontals**
- **Operate at reduced FV**
- **Smaller hoods**


Reducing Fume Hood Flow
Restrictions
Control flow based on use patterns
• Sash Stops
• Horizontals
• Operate at reduced FV
• Smaller hoods
• Vary flow with sash position
• Let hood occupancy control FV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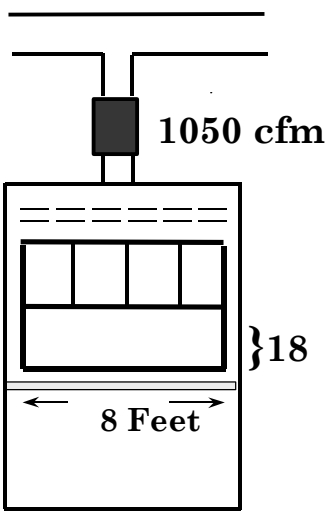
Restrictions



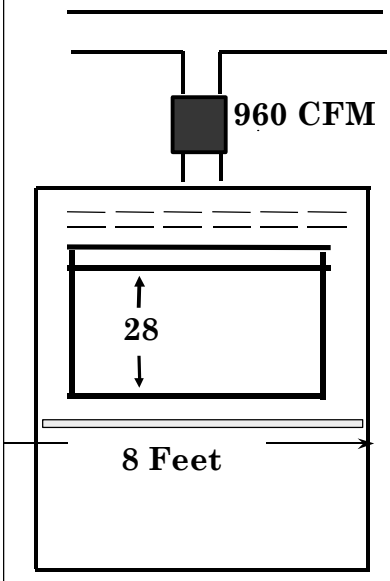
Restrict hood flow to 18 Sash:

1050 cfm vs. 1600 cfm

Add horizontal sashes
Containment???
Low FV when sash stop is overridden

Saves: $1650/year/hd
Needs: 265,000CFM

Restrictions



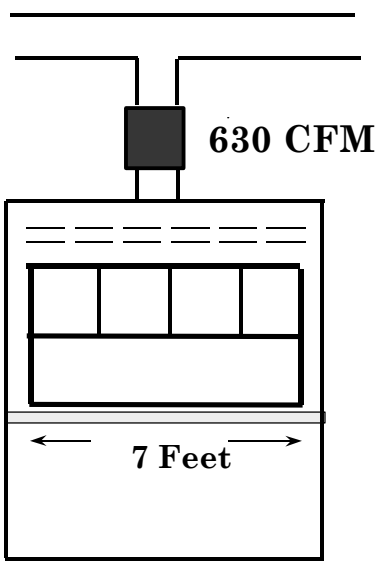
Restrict hood flow to 60 fpm:

960 cfm vs. 1600 cfm

Containment ???
Dynamic conditions

Saves: $1900/year/hd
Needs 240,000 CFM

Restrictions



Restrict hood flow to 18 sash, use 60 fpm, 7 hood

630 cfm vs. 1600 cfm

Saves: $2900/year

Needs 160,000 CFM

Sash stops/override
Containment risk?
Smaller hoods

Reducing Fume Hood Flow

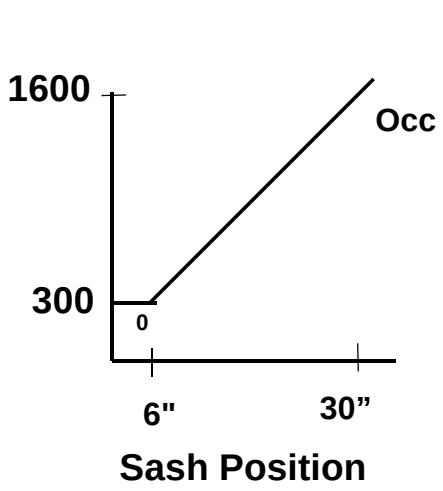
Restrictions

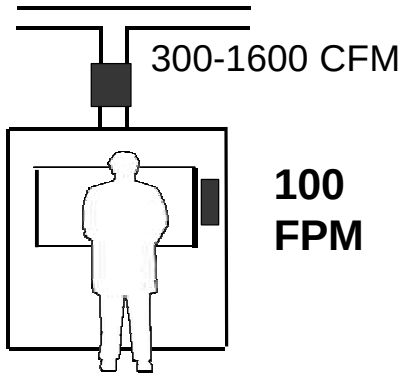
- Sash Stops
- Horizontals
- Operate at reduced FV
- Smaller hoods

Control flow based on use patterns

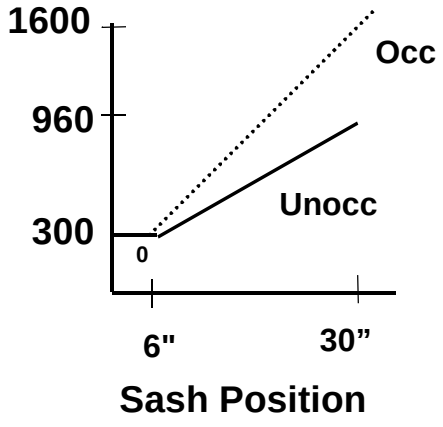
- Vary flow with sash position
- Let hood occupancy control FV

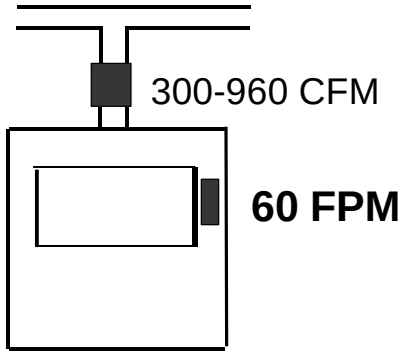
Hood Usage Control



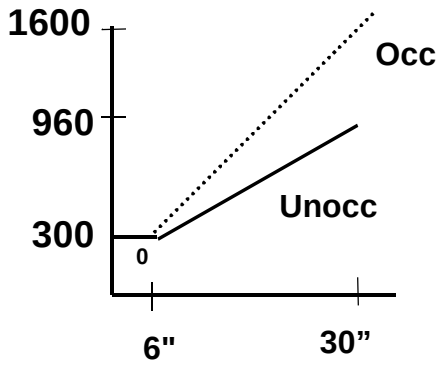


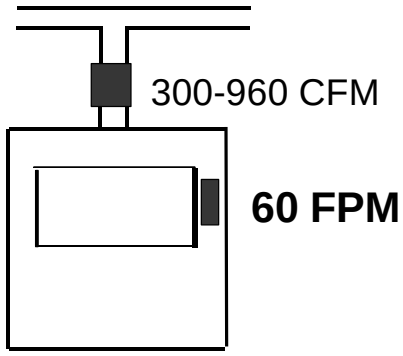
Hood Usage Control





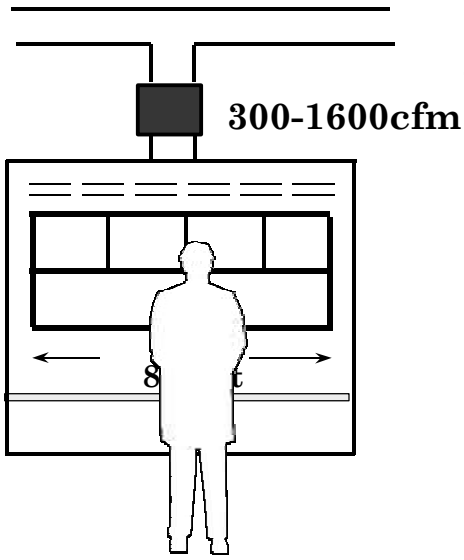
Hood Usage Control





Reference:
ASHRAE Paper CH-99-09

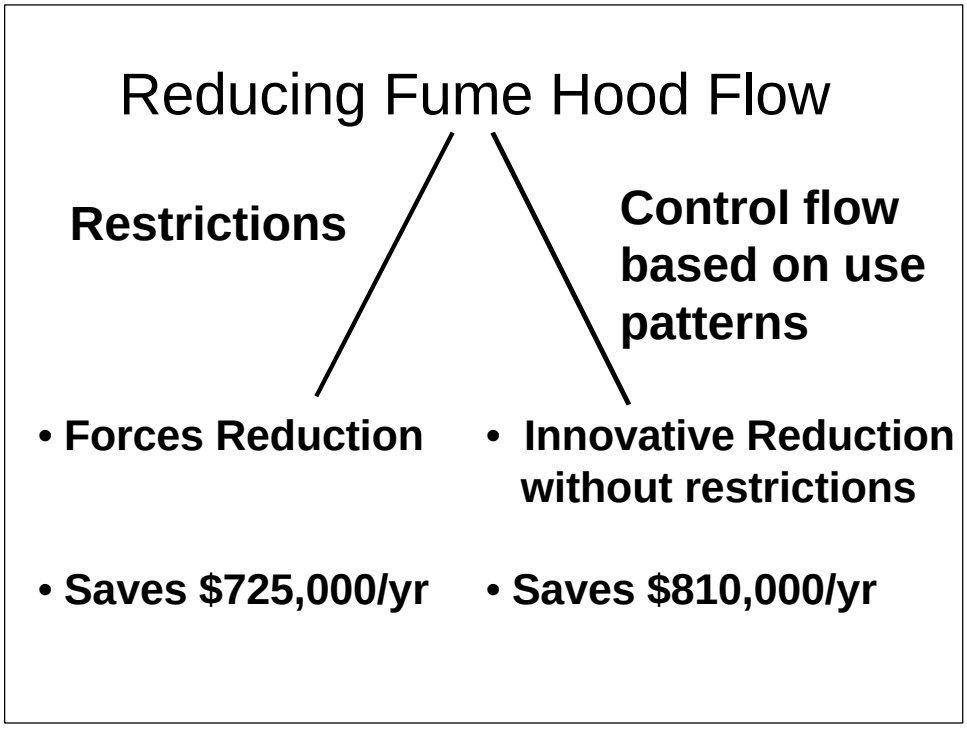
Usage Patterns



Flow control based on sash/occupancy

520 vs. 1600 cfm
- **Saves: $3240/year**
- **Uses 130,000 cfm**

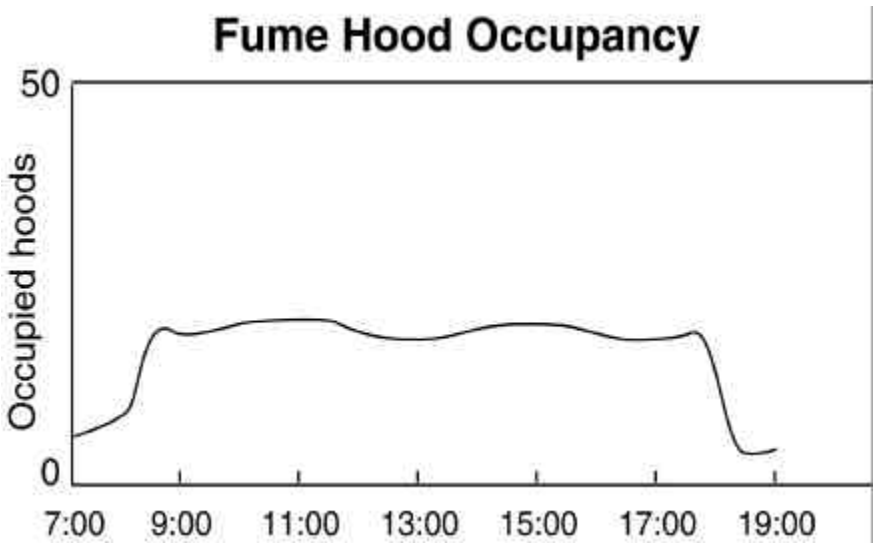
Always a safe face velocity
Flexibility of use
8 ft hoods



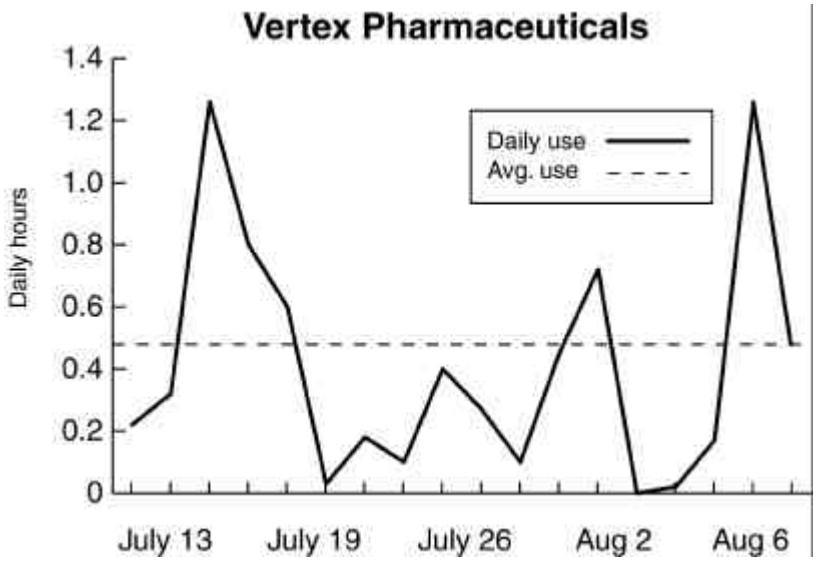
Factors that Affect Fume Hood System Sizing

- Quantity of Hoods (250)
- Flow Set Points (100 FPM or 60 FPM?)
- Usage Patterns
  - When?
  - How long?
  - Sash management habits?
- Manifold size

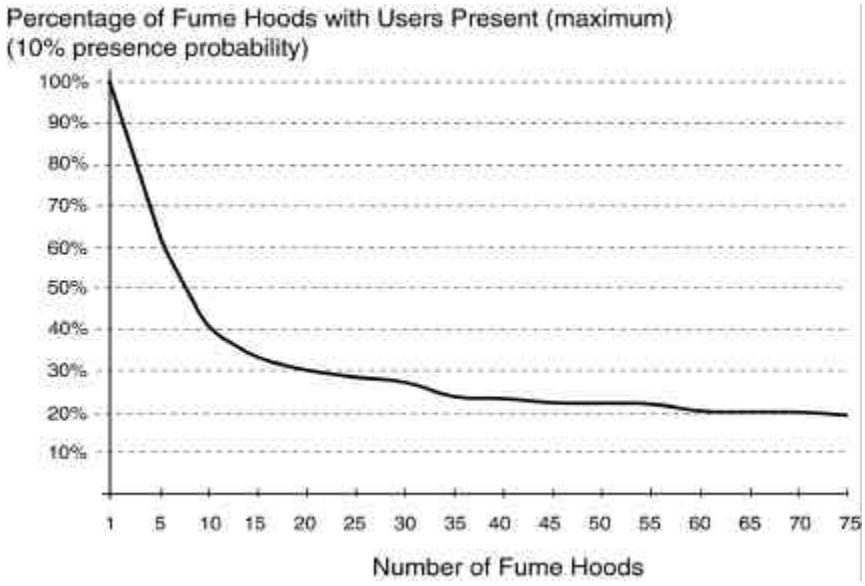
Random Use[2]



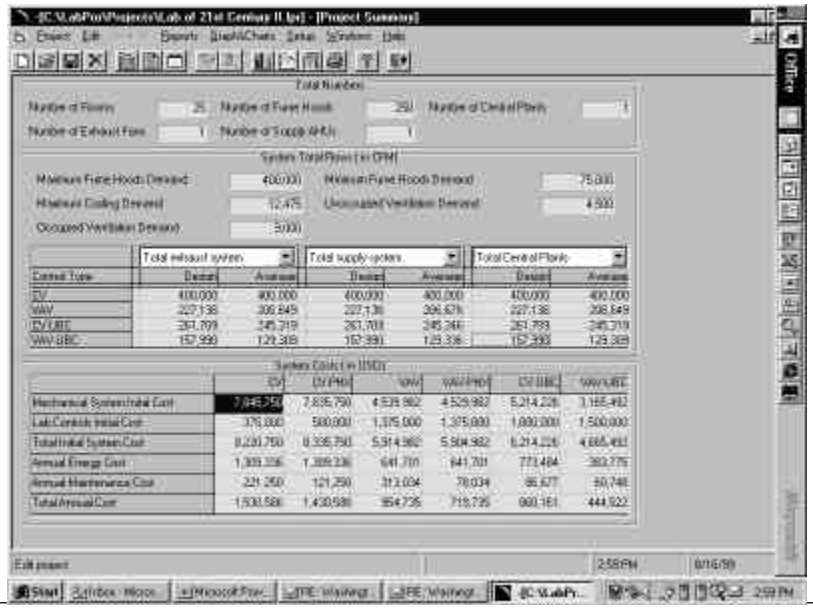
Typical Hood Occupancy: About 1 Hour a Day[2]



Hood Occupancy Stats



Software[3]



Case Study: University of Richmond

- Chemistry Building with 40 fume hoods using 56,000 CFM
- Needed 60 hoods
- They chose Usage Based Technology
  - Added 20 new hoods (from 40 to 60) without adding mechanical equipment
  - Yet the building operates at 28,000 CFM!
  - Cured existing problems, saves energy ($80K+/year), and reduced maintenance

Boehringer Ingelheim Ridgefield, CT

- Local utility provided a $159,700 rebate for installing a VAV/UBC approach
- Annual Energy Savings: $160,000
- Received FAME award energy efficient design (Facilities Management Award of Excellence)

Bristol Myers, Evansville

- 57 Hood Retrofit
- 30% ROI
- Annual Energy Savings: $180,000
- SIGECO Incentive $250,000 for Usage Based Technology

Sources

1. Containment Testing for occupied and Unoccupied Laboratory Chemical Hoods - ASHRAE Paper CH-99-9-1. January 1999
2. Phoenix Controls Field Study, 114 hoods @ 35 different sites, October 1993 - July 1994
3. LabPro™
4. Energy calculations based on $3/CFM/year

Achieving Energy Efficient Laboratory Buildings

Control Flows Based on Usage Patterns

www.phoenixcontrols.com